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Abstract

THE USES AND POTENTIALITIES OF RESEARCH REACTORS

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The use of nuclear reactors as research tools is now more than two decades old. The list of experimental techniques possible with nuclear reactors is very long. The applications of these techniques are numerous, and additions are made at a steady rate in nearly all branches of science and technology.

Most of the research with reactors has been done with machines offering maximum thermal neutron flux levels between 10^{12} and 10^{14} neutrons/cm²-second. The effective flux level for many kinds of experiments has been well below the maximum values possible. In addition, some research reactors have been designed with too little, if any, attention given to the best energy spectrum of the neutrons to be used, and to background levels. The limitations on flux levels and the lack of purity of the radiation have hindered experiments.

A new generation of research reactors seeks to reduce these problems by providing design features that are more nearly optimum for the experiments that are planned. The neutron flux is shaped in space, time, and energy, to improve the useful fraction of neutrons, and to reduce the undesirable components of the radiation.

In this paper we discuss the nuclear research reactors that have been of most interest in the United States. A historical review indicates how the trends in engineering and the nature of the research that was planned led to the types of reactors commonly used.

A review of the state of applications of research reactors is given. The capabilities of different kinds of research reactors, both present and future, for the different areas of research is discussed, including consideration of the flux intensities and characteristics that a research reactor

should have for competitive research. An analysis is made of the degree to which the advanced reactors now being built approach the features that the ideal research reactor should have.

We also discuss use of research reactors at nuclear centers in developing countries, with attention given to both the features of the reactors and the types of programs that would be fruitful. Recommendations are given on how to use the reactors in these centers to produce research competitive with that done in larger and more advanced nuclear centers.